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ABSTRACT

This study attempted to elucidate the effects of context and level of processing on comprehension and memory for prose. Two aspects of memory for prose were investigated: the amount of information remembered and the semantic interpretation assigned to ambiguous paragraphs. Task instructions and exposure duration of the passages were manipulated to induce different levels of processing and to affect the amount of information retained. In order to influence the interpretation of the ambiguous paragraphs, different contexts, in the form of titles which would create bias, accompanied the text. Recall and recognition measures indicated that students remembered more information and more context-consonant information when given instructions which required processing the paragraphs at a semantic level. Thus, context determined which meaning was remembered from polysemous paragraphs only when incoming information was processed at a deeper, more semantic level. Tables of findings are included. (Author/JM)

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Technical Report No. 5

IMPROVING MEMORY FOR PROSE: THE RELATIONSHIP BETWEEN DEPTH OF PROCESSING AND CONTEXT

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November 1975

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Abstract

Two aspects of memory for prose were investigated, the amount of information remembered and the semantic interpretation assigned to ambiguous paragraphs. Task instructions and exposure duration of the passages were manipulated to induce different levels of processing and affect amount of information retained. In order to influence the interpretation of the ambiguous paragraphs, different contexts, in the form of biasing titles, accompanied the text. Recall and recognition measures indicated that students remembered more information and more context-consonant information when given instructions which required processing the paragraphs at a semantic level. Thus, context was a powerful determiner of which meaning was remembered from polysemous paragraphs only when incoming information was processed at a deeper, more semantic level.

This study attempts to elucidate the effects of context and level of processing on comprehension and memory for prose. Bransford and Johnson's (1972) study of contextual prerequisites to understanding prose stands as a precursor to the present research. These investigators found that memory for seemingly nonsensical paragraphs was dramatically improved when the paragraphs were preceded by appropriate contexts in the form of pictures or short titles. The effectiveness of context resided in making the paragraphs comprehensible by accessing relevant, already learned knowledge. Thus, Bransford and Johnson provided strong evidence that context can increase the amount of information remembered from prose. However, another important effect of context on the acquisition of information, its specifying nature, has been ignored by investigators of memory for prose. Context not only may make vague passages perfectly comprehensible, it also may affect the interpretation of messages which have two or more meanings. The present investigation is focused upon this heretofore neglected function of context, its biasing effect upon comprehension of prose.

The effects of context cues as specifiers of meaning can best be tested when the cues are presented along with verbal messages which are potentially interpretable in two ways. For the present study, paragraphs were constructed which were ambiguous because they permitted two semantically different interpretations. For example:

> In the last days of August, we were all suffering from the unbearable heat. In a few short weeks, our daily job had turned from a game into hard labor. "All we need now," said the manager in one of his discouraged moods, "is a

strike." I listened to him silently but I could not help him. I hit a fly. "I suppose things could get even worse," he continued. "Our most valuable pitchers might crack in this heat. If only we had more fans, we would all feel better, I'm sure. I wish our best man would come home. That certainly would improve everyone's morale, especially mine. Oh well, I know a walk would cheer me up a little."

Note that in contrast to the materials of Bransford and Johnson (1972), Dooling and Mullet (1973), or Dooling and Lachman (1971), the above passage is ambiguous not because it is vague and leaves intended referents unspecified (Haviland & Clark, 1974), but because it allows two relatively concrete meanings to be constructed. The paragraph can be taken as representing an interaction between the manager of a losing baseball team and one of his players. At the same time, the paragraph can be construed in terms of an interaction between the manager of a glassware factory and one of his employees. While both interpretations are permitted by the passage, it is probable that they are not equally likely. To determine the relative dominance of one meaning over another, the ambiguous paragraphs were presented to a norming group. A more frequently perceived meaning, labelled a "strong" meaning, and a less frequently perceived meaning, labelled "weak," were established for each passage. The passages could then be presented along with two types of context, one which cued the strong meaning of the paragraph and one which cued its weak meaning. Examples of contexts which evoke the strong and weak meanings for the above paragraph are the titles "Worries of a Baseball Team Manager" and

"Worries of a Glassware Factory Manager." Students' memory for the passages was assessed first on a free recall test, and then on a multiple-choice test whose alternatives discriminated between the two possible interpretations of each paragraph.

While no previous research has dealt with the selective effects of context upon prose, there is related research dealing with memory for words and sentences which can guide predictions of results in the present study. For example, in an extension of Tulving and Thomson's (1973) version of the encoding specificity hypothesis, Reder, Anderson, and Bjork (1974) presented evidence which suggests that subjects are likely to remember whatever semantic representation is formed during the comprehension stage. These investigators found that certain context cues acted to specify the meaning of polysemous words and thus determined performance on later recognition and recall tests. In a similar vein, Anderson and Ortony (1975) found that certain words were interpreted differently when embedded in sentences which primed different meanings of the words. In addition, a number of studies have provided evidence that an ambiguous sentence is immediately interpreted one way but is reconsidered automatically if a context consonant with a second meaning of the sentence appears (Carey, Mehler, & Bever, 1970; Foss, 1970; Foss, Bever, & Silver, 1968). It seems reasonable to expect similar context effects in the comprehension and memory of ambiguous paragraphs. For the present study, the prediction was that recognition performance would reflect the interpretation assigned to the paragraphs during the comprehension process. Thus, it was expected that readers who were constrained to perceive one meaning of

a paragraph by the presence of a particular context would choose more alternatives on a multiple-choice test which were consonant with this meaning than alternatives consonant with the other meaning.

An assumption made in the foregoing predictions is that the readers are processing the paragraphs at a semantic level. It seems apparent that were they paying attention to physical characteristics of the passages, a biasing context would not influence them. An interaction between level of processing and context effects can be predicted from the Craik and Lockhart (1972) model, although the model has not previously been extended to include specificity of meaning effects. Craik and Lockhart's original conception predicts a direct relationship between depth of processing and the strength of the memory trace. Here, depth of processing refers to a hierarchy of stages through which incoming stimuli are processed, where preliminary stages involve the analysis of physical features and later stages are concerned with the extraction of meaning. Craik and Lockhart intend greater "depth" to refer to a greater degree of semantic analysis--the more deeply or semantically a stimulus is analyzed the more elaborate, longer lasting, and stronger its memory trace will be. The deepest levels of processing involve "enriching" the stimuli by tying them to previously acquired associations, images, and other relevant pre-existing knowledge. While more time to process stimuli will usually result in deeper processing, the most influential variable affecting depth of processing is task demands. Tasks which require rote learning or attention only to physical features of stimuli will not affect memory performance as much as tasks which demand semantic processing. Only a simple elaboration of

Craik and Lockhart's conception is needed to predict an interaction between levels of processing and context. If context is assumed to improve memory by accessing previously acquired cognitive structures to serve as anchor and framework for new information, only readers who are processing the paragraphs meaningfully will be influenced by the content of their primed existing knowledge.

In addition to ensuring a greater degree of context-appropriate responses, greater depth of processing, as operationalized by different task demands and presentation durations, should affect how much is remembered from prose passages. Tasks which require semantic processing are known to yield an increase in total amount of information remembered over non-semantic tasks (Bobrow & Bower, 1969; Craik, 1973; Frase & Kammann, 1974; Mistler-Lachman, 1972, 1974). In the present study, four types of tasks and two different presentation durations were chosen to represent a continuum of depth of processing. The levels of the presentation duration variable were fixed at 20 and 45 seconds based upon a pre-experimental test of minimum and maximum times needed to perform the experimental tasks. Of the four types of instructions, the most "shallow" task involved asking subjects to count the number of four-letter words in the passages. Counting the number of personal pronouns would seem to require a somewhat deeper, probably syntactic, processing of individual words. A third task involved rating the passages for degree of ambiguity, a task which demands processing the material in a meaningful way and should result in much improved recall when compared to the previous two tasks (Bobrow & Bower, 1969). It was predicted that better recall and more

specific and accurate recognition performance would be exhibited by the fourth instruction group asked to read and learn the paragraphs.

In summary, the present research was an attempt to investigate not only how much a person remembers, but what exactly he remembers from ambiguous paragraphs whose semantic representations can be influenced by different contexts. It was predicted that whichever meaning was assigned during the study of ambiguous paragraphs would be the meaning which was recalled and recognized, and that the selection of one or the other meaning would be constrained by weak-meaning-related and strong-meaning-related contexts. This relationship was more likely to appear when readers were instructed to deal with incoming stimuli on a semantic level than when they were enjoined to perform less semantic tasks. With the "shallower" tasks, it was predicted that context cues might minimally direct processing toward one or the other meaning of the passages but that, on the whole, memory would be reduced and inaccurate.

Method

Design

Four levels of Tasks (counting four-letter words, counting personal pronouns, rating for ambiguity, and learning) were factorially combined with two levels of Presentation Duration (20 and 45 seconds) to yield eight independent cells. Three types of context cues (strong, weak, none) were tested as a within-subject variable. Thus, the design was a 4 (Tasks) x 2 (Duration) x 3 (Context) mixed design with repeated measures on the context variable.

Subjects

Eight groups of 18 subjects were randomly formed from a pool of volunteer students enrolled in an undergraduate education class at Arizona State University.

Materials

Paragraph construction. Three short paragraphs of 114, 114, and 120 words were constructed so as to be completely ambiguous. An ambiguous passage is defined here as one which can be construed as describing two different situations. Thus the term ambiguity in the present context is not meant to apply to simply abstract passages, or passages with generally undetermined referents. The three paragraphs in their final form were:

Baseball/Factory

In the last days of August, we were all suffering from the unbearable heat. In a few short weeks, our daily job had turned from a game into hard labor. "All we need now," said the manager in one of his discouraged moods, "is a strike." I listened to him silently but I could not help him. I hit a fly. "I suppose things could get even worse," he continued. "Our most valuable pitchers may crack in this heat. If only we had more fans, we would all feel better, I'm sure. I wish our best man would come home. That certainly would improve everyone's morale, especially mine. Oh well, I know a walk would cheer me up a little."

Cards/Music

Every Saturday night, four good friends get together. When Jerry, Mike and Pat arrived, Karen had just finished writing some notes. She quickly arranged the cards and stood up to greet her friends at the door. They followed her into the living room and sat down facing each other. They began to play. Karen's recorder filled the room with soft and pleasant music. Her hand flashed in front of everyone's eyes and they all noticed her diamonds. They continued for many hours until everyone was exhausted and quite silly. Jerry made his friends laugh as he theatrically took a bow, entertaining them all with the wildness of his playing. Finally, Karen's friend went home.

Box/Lawsuit

John, a salesman for a wine company, heard on the early evening news show that certain wines were being altered on their way to market by being artificially colored. The next day, while examining a box of wine, he noticed in a corner a foreign character almost completely concealed. John brought the case up to the company owner. The owner, although very busy, dropped what he was doing and considered the matter carefully. Picking up the glasses on his desk, the owner said, "We'll have to try the case." Other company officials gathered in his office and heard him announce, "I expect that every hand which touched this wine was stained to some degree."

Each paragraph contained six ambiguous features. Three kinds of ambiguous features, lexical, surface structure, and underlying structure ambiguities, have been studied previously (Foss, 1970; MacKay, 1966; Mackay & Bever, 1967). In the present set of materials, however, concern over type of ambiguity was subordinated to an attempt to make each paragraph ambiguous as a whole. The paragraphs also contained an equal number of idea units (28). The number of idea units was determined individually, and then in conference by three raters who were given Bransford and Johnson's (1973) definition of idea units as "individual sentences, basic semantic propositions or phrases" (p. 393). The raters were in agreement on 89%, 86%, and 64% of the original demarcation of units. All disagreements were resolved by consensus.

The perceptibility of each meaning in the paragraphs was determined by asking 99 college students to read the three passages and answer two questions which followed each. The questions were phrased so that it was possible to ascertain which meaning had been perceived from a particular passage. Three scorers tabulated the frequency of occurrence of each meaning. Results indicated that there was a definite preponderance of one meaning over another for each passage, thus defining strong and weak meanings for each. For example, for the Baseball/Factory paragraph, 86% of responses indicated a "baseball" interpretation and 14% a "factory" interpretation of the paragraph.

Experimental booklets. The experimental material was compiled in seventeen-page booklets. General as well as task-specific instructions appeared on the first page. Then the following series was replicated three

times: a context page, with either a strong-meaning title, a weak-meaning title, or no title at all was followed by a paragraph which was followed in turn by a task answer sheet. Every subject saw all three paragraphs, one at each level of the context variable. Order and topic of paragraph were combined in a three-level Latin square which was repeated for all six possible orders of type of context. Thus each paragraph was represented equally within independent groups of subjects at each possible position, within each possible context.

The context-producing titles took the form of six-word phrases such as, "Worries of a Baseball Team Manager" cueing the strong meaning of the Baseball/Factory paragraph, and "Worries of a Glassware Factory Manager" cueing the weak meaning. The task answer sheets were appropriate to the instructions given to subjects. For example, subjects rating the paragraphs for ambiguity saw a three-point check list with each point labeled "completely ambiguous," "somewhat ambiguous," and "completely unambiguous." Following the last answer blank, a page of arithmetic problems was included to preclude primary memory effects during the recall test.

The retention measures took the form of a recall test followed by a multiple-choice test. On each of three pages, the first idea unit plus the subjects of the next phrase was printed at the top of the page to provide subjects with enough information to begin appropriate free recall. For example, one of the paragraphs was cued by the words, "In the last days of August, we." Recall tests were presented in the same order as the paragraphs. Similarly, the recognition tests were presented in the same order as the paragraphs. Eight four-alternative multiple-choice

questions were constructed for each passage. Two of the eight questions tested knowledge of some unambiguous information in the paragraphs. The remaining six questions were cued to each of the ambiguous features of tne paragraphs. The four alternatives for each question included one which was consonant with one meaning and a second which was consonant with the alternate meaning of the ambiguous passages, plus two irrelevant possibilities differing minimally in lexical and structural elements from the two relevant possibilities.

Procedure

Subjects participated in small groups of from one to seven persons with most groups made up of four persons. An experimenter handed out to each subject the first part of the experimental booklet (up to and including the arithmetic problems). Subjects then heard and read task-appropriate instructions: counting the number of four-letter words in the passages, counting the number of personal pronouns, rating each paragraph for degree to which it represented more than one meaning, or learning and rating each paragraph for degree of difficulty to learn. Subjects turned to the first title page, read it for five seconds, then turned to the passage and read it for 20 or 45 seconds depending upon their duration condition. Subjects were allowed five seconds to enter their response on the task answer blank. The same procedure was followed without any break for the second and third paragraphs and their corresponding title and task sheets. A total of 60 seconds elapsed from the moment the subjects began the math sheet until they were told to stop. The

experimenter then gathered the paragraphs and handed out free recall sheets with instructions for subjects to write down all they could remember from the paragraphs. Seven minutes were allowed for the free recall task. Next, the experimenter collected the recall sheets and handed out the multiple-choice test. The instructions stressed the need to circle one alternative for every question even if the chosen answer was based upon a pure guess. This last section was self-paced.

Results

Results were analyzed to answer two sets of questions: 1) how much was retained from the three passages, and 2) specifically what was remembered from the texts.

Amount of Information Retained

Recall. Idea unit scores were obtained by comparing subjects' free recall protocols to a pre-established list of idea units contained in each passage. One idea unit was always provided as a cue to identify the paragraph requested, thus reducing the total possible to 27. Any meaning-preserving approximation of an idea unit was accepted. As both Cofer (1973) and Zangwill (1972) found, subjects in the present study rarely wrote down an erroneous idea. Rather the most common error was one of omission. Whenever a fabrication did occur, it was not counted toward the total recall score. The protocols were scored by one of two raters. Interrater reliability on number of idea units for a sample of 40 protocols was .97.

A three-way mixed analysis of variance, with four levels of Tasks (counting four-letter words, counting pronouns, rating for ambiguity, learning) and two levels of Duration (20 and 45 seconds) as between factors, and three levels of Context (strong, weak, and none) as a within factor, resulted in significant effects for Tasks, F (3,136) = 82.56, $p < .001$, and for Duration, F (1,136) = 12.65, $p < .001$. A significantly greater proportion of idea units were recalled with passage exposure times of 45 seconds (mean proportion = .15) than with exposures of 20 seconds (M = .10).

The means of the four task instruction groups were subjected to Newman-Keuls tests. Results indicated that the means ranked themselves as follows: counting four-letter words (mean proportion of idea units = .02) = counting pronouns (.04) < rating for ambiguity (.21) = learning (.24), $p < .01$. Both of the "shallower" processing instructions resulted in substantially less recall than the "deeper" comprehension tasks.

To determine how much of the total variance in performance on the free recall tests was attributable to experimental treatment, omega squared (ω^2) values were calculated for the tasks and duration variables. While Duration accounted for only .02 of the variance, the task instructions accounted for .44, indicating an unusually effective control of variability in recall performance as a function of the task instructions employed in this study.

Recognition: Control questions. In each of the paragraphs, there was some information which was not ambiguous and, therefore, was correctly representable in only one sense. Two multiple-choice questions per

paragraph were constructed testing knowledge of this information. The number of correct responses on these control questions was assumed to reflect in a gross manner how much attention the subjects paid to the information content of the passages.

Results of a 4 (Tasks) x 2 (Duration) x 3 (Context) mixed analysis of variance indicated that only the tasks variable produced a significant difference in number of correct recognition responses on the control questions, F (3,136) = 22.92, $p < .001$.

The means of the different task instruction groups, reported as mean proportions of questions answered correctly, were counting four-letter words (.55), counting pronouns (.55), rating for ambiguity (.80), and learning (.80). Newman-Keuls tests again indicated that the two less semantic tasks were not different from each other but resulted in significantly poorer performance, $p < .01$, than the two more semantic tasks which were in turn not different from each other. The ω^2 value for these effects indicated that task instructions accounted for .10 of the variance.

Recognition: Total information. The remaining six questions for each of the paragraphs presented four alternatives: one which was consonant with a strong meaning interpretation of the passage, one consonant with a weak meaning, and two alternatives which did not represent correct information from the passages. Regardless of context cues, the "correct" alternatives reflected information represented in the passages. Therefore, as a third measure of total amount remembered, the number of questions for which either of the "correct" alternatives were chosen was tabulated and analyzed.

A 4 (Tasks) x 2 (Duration) x 3 (Context) mixed analysis of variance, with repeated measures on the context variable, resulted in significant effects for Tasks, F (3,136) = 27.99, $p < .001$, for Duration, F (1,136) = 11.71, $p < .001$, and for Context, F (2,272) = 3.98, $p < .02$. Again, longer exposure to the paragraphs resulted in greater amount of information remembered. The mean proportion of total "correct" recognition responses of the 20-second exposure condition was .67, and of the 45-second condition, .73. None of the interactions between variables approached significance.

Newman-Keuls tests performed on the task effect replicated the pattern of results obtained with the recall of idea units and the control recognition measures. Namely, the means, reported as mean proportions, ranked themselves as follows: counting four-letter words (.60) = counting pronouns (.60) < rating for ambiguity (.78) = learning (.80), $p < .01$. Again, both "shallower" tasks resulted in significantly lower total information recognition scores than the two more semantic tasks.

Mean proportions as a function of type of context decreased from strong (.73), to weak (.70), to none (.67). Newman-Keuls tests indicated that only the difference between strong context and no context was significant, $p < .05$.

Omega squared values were calculated for each of the significant effects. For task instructions, $\omega^2 = .15$, again accounting for a relatively large amount of the variance in performance. The duration and context manipulations controlled only .02 and .01 of the total variance respectively.

Specificity of Information Retained

Recognition: Strong-meaning responses. The number of questions which were answered by choosing the strong-meaning alternatives was tabulated. These scores were taken as representing strong meaning encoding.

The mean proportions of responses consonant with a strong-meaning interpretation of the paragraphs are presented in Table 1. A 4 (Tasks) x 2 (Duration) x 3 (Context) mixed analysis of variance, with repeated measures on the context variable, resulted in significant effects for the task, F (3,136) = 3.67, $p < .02$, and context variables, F (2,272) = 23.21, $p < .001$, and for the Tasks x Duration interactions, F (3,136) = 3.02, $p < .05$.

Insert Table 1 about here

Post hoc tests on the task main effect did not reveal any significant differences. Apparently, the effects of the Tasks x Duration interaction acted to obscure differences among the four instruction groups when analyzed as main effect. Simple effects analyses were performed to determine the source of significant differences in the interaction. Results indicated that with 20-second exposures to the paragraphs, task instructions significantly affected the number of strong-meaning responses selected, F (3,136) = 17.04, $p < .001$. The two "shallower" tasks differed from the two "deeper" tasks on all t-test comparisons of means, $p < .02$. At the 45-second exposure time, task instructions did not produce differences in choosing strong-meaning alternatives. Tests of differences in performance at the two time exposures within each task instruction

level resulted in a significant difference only between the 20-second group and the 45-second group who had been given instructions to count number of four-letter words, F (1,136) = 7.61, $p < .01$.

Newman-Keuls tests on the Context means indicated that a significantly greater number of strong-meaning responses were made with paragraphs presented with strong-meaning titles (mean proportion of strong-meaning recognition responses = .50) than with paragraphs presented either with weak-meaning titles (.30) or no titles (.35), $p < .01$. These latter two conditions did not differ significantly from each other.

The Tasks x Context interaction, represented in columns 2, 6, and 9 of Table 1, approached conventional significance levels ($p < .09$). With caution, it is possible to interpret these data as illustrating a trend which was consonant with theoretical and pre-experimental predictions. Thus, with the two tasks which require semantic encoding, the rating for ambiguity and normal learning instructions, context-producing titles seemed to influence the proportion of choices of strong-meaning alternatives. For these two processing tasks, paragraphs presented with strong-meaning titles produced more strong-meaning responses than paragraphs presented with weak titles. When paragraphs appeared without any title, an intermediate number of responses indicated a strong-meaning interpretation of the paragraphs. However, the two counting instructions did not produce the same pattern of responses across levels of context. Fewer strong-meaning responses were exhibited in all context conditions and the means ordered themselves in descending order from strong to weak to none.

Calculated omega squared values revealed that .09 of the total variance was attributable to the context manipulation, .01 to the task instruction effect, and .01 to the Tasks x Duration interaction.

Recognition: Weak-meaning responses. The number of multiple-choice questions where subjects chose the weak-meaning alternative was analyzed to reveal effects of the experimental manipulations upon encoding of weak-meaning information in ambiguous passages.

The mean proportion of responses consonant with a weak-meaning interpretation of the paragraphs appear in Table 2. In a 4 (Tasks) x 2 (Duration) x 3 (Context) mixed analysis of variance, with repeated measures on the third variable, significant effects were found for the tasks, F (3,136) = 11.09, $p < .001$, and context main effects, F (2,272) = 18.99, $p < .001$, and for the Tasks x Duration, F (3,136) = 6.88, $p < .01$, and Tasks x Context interactions, F (6,272) = 2.63, $p < .02$.

Insert Table 2 about here

Newman-Keuls tests comparing the means of the four instructions groups revealed that subjects instructed to count the number of four-letter words in paragraphs chose fewer weak-meaning alternatives than subjects given instructions to process the passages at a semantic level (rating for ambiguity and normal learning). The pronoun-counting group performed at an intermediate level which did not differ significantly either from the two semantically-instructed groups or from the four-letter-word group.

Context-producing titles influenced the number of weak-meaning alternatives selected. Subjects chose a significantly greater proportion of weak-meaning alternatives for paragraphs presented with weak-meaning titles (.40) than for paragraphs presented either with no titles (.30), $p < .01$, or with strong-context titles (.23), $p < .01$. Paragraphs presented with no titles were more likely to be encoded according to a weak-meaning interpretation than paragraphs presented in the context of strong-meaning titles, $p < .01$.

The Tasks x Duration interaction indicated that, within the 20-second level, comparisons of cell means using t-tests replicated an earlier pattern: the two counting tasks were significantly lower than the two semantic tasks, $p < .01$. However, when paragraphs were exposed for 45 seconds, the only instruction which resulted in a significantly lower mean number of weak-meaning choices was the counting four-letter word task, $p < .01$.

Of all effects which were significant in the present study, the most interesting for memory specificity was the Tasks x Context interaction shown in columns 2, 6 and 9 of Table 2. Simple effects analyses indicated that the mean proportion of alternatives selected which were consonant with the weak meaning of the passages was not affected by level of processing as represented by task instructions, when the paragraphs had been presented in the context of strong-meaning titles. In the presence of weak-meaning titles, more weak-meaning alternatives were chosen with semantic task instructions (rating for ambiguity and normal learning) than with less semantic task instructions, $p < .01$. When paragraphs were

presented without any titles, the number of weak-meaning responses increased as tasks became more semantic, but at a much less dramatic rate than that exhibited with weak-meaning titles, F (3,408) = 2.82, $p < .05$. Only the group of subjects counting four-letter words chose significantly fewer weak-meaning responses than the two semantic instructions, $p < .05$.

Omega squared values reflecting the amount of variance accounted for by experimental treatments showed that task instructions accounted for .05, context cues for .07, and each of the significant interactions for .02 of the total variance.

Recall: Specificity of responses. Before the data were collected, plans for scoring the recall of idea units had called for separately counting the number of ideas consonant with each possible meaning of the paragraphs. An examination of recall protocols revealed the impossibility of filling this plan. Subjects most often wrote essays as ambiguous as the ones presented to them during acquisition. That is, it was usually impossible to determine which meaning of a passage had been selected. Therefore, no attempt was made to analyze recall of idea units for specificity of encoding.

Discussion

Results clearly indicated that context-producing titles predictably influenced the comprehension and memory of prose passages. The paragraphs in the present study were ambiguous in the sense that they allowed two interpretations. The relative probability of these two interpretations was determined in a pre-experimental rating task, thus specifying a strong

and a weak meaning for each passage. In the recognition test phase of the memory experiment, the learners chose more strong-meaning alternatives for paragraphs which had been preceded by a strong-meaning title than for paragraphs which had appeared with a weak title. Similarly, more weak-meaning alternatives were chosen for paragraphs presented with weak titles than for those with strong titles. For both types of response measures, paragraphs presented without any title resulted in more responses than paragraphs preceded with inconsistent contexts. That is, the students chose more strong-meaning alternatives for paragraphs without titles than for paragraphs with weak titles and they chose more weak-meaning alternatives for paragraphs without titles than for paragraphs with strong-meaning alternatives. Thus, a semantic interpretation of encoding specificity was supported with ambiguous prose passages. The weak- and strong-meaning recognition measures indicated that the information content of the paragraphs was encoded in the context represented by the titles.

Also of considerable interest is the reliable interaction on strong- and weak-meaning response measures between levels of processing, induced by different task instructions, and context. When given instructions which presumably induced a deeper processing of the paragraphs, the readers not only acquired a greater amount of information but they also exhibited a greater sensitivity to the context provided. In terms of the depth of processing model, when readers are instructed to rate a paragraph for ambiguity or to learn it, they are likely to process it in a meaningful way. As Craik and Lockhart (1972) proposed, semantic processing involves

accessing previously stored information and cognitive structures and relating them to the new incoming information. One obvious effect of providing readers with an appropriate context should be to facilitate the accessing of existing cognitive structures. In the present study, for students involved in semantic tasks, the titles automatically provided a framework for building a semantic representation of the passages. As indicated in Tables 1 and 2, which framework became activated was a function of the title presented with the paragraphs. Responses were constrained particularly well when subjects were processing the material at a level which "used" the framework. Thus, subjects given instructions to rate for ambiguity or to learn chose many strong-meaning alternatives for the paragraphs given a strong-meaning context and very few for the paragraph given a weak-meaning context. They performed in a context-appropriate manner with the weak-meaning responses as well. On the other hand, subjects who counted four-letter words and pronouns did not reflect the effect of titles upon specificity of encoding. Possibly, for these subjects, the titles activated pre-existing cognitive structures but, since incoming stimuli were not given meaningful representation, no new information could be added to the information framework cued by the titles. Titles alone were not effective in producing correct performance on a multiple-choice test, whether measured in terms of number of strong-meaning or of weak-meaning responses. Thus, the effects of context were restricted to conditions which involved meaningful representation of the verbal material.

It may seem surprising that such strong context effects were produced by simple six-word phrases presented as titles. Other studies and everyday

observations support the present findings, however. For example, Lackner and Garrett (1972) found that subjects in a dichotic listening task, who shadowed an ambiguous message presented to one ear, later interpreted the message in the context provided by information presented to the unattended ear. The unattended passage biased responses even though subjects were unable to report the context-producing information. As in the present study, context was a powerful determiner of the meaning assigned to verbal messages. As in everyday encounters with verbal messages, the smallest hint of context seems to constrain and disambiguate potentially ambiguous communications.

The amount of information retained, as contrasted with its content, was not nearly as subject to context effects. Providing readers with a six-word title before paragraphs was not effective in increasing the number of idea units recalled. These results are in contrast to those of Bransford and Johnson (1972), Dooling and Lachman (1971), and Dooling and Mullet (1973), who found that titles or short phrases describing the content of paragraphs significantly increased free recall. Clearly the differences in stimulus materials account for the contrasting results. In the present study, the paragraphs were ambiguous but only in the sense that they could be interpreted as describing two concrete situations. The learners were able to build at least one semantic representation immediately upon perceiving the paragraphs. In past studies of the effects of context, the passages have been made purposefully vague and metaphorical, and have included a number of unspecified referents and antecedents. Upon reading the "flying a kite" passage of Bransford and Johnson (1972)

for example, one is struck by the incoherence of the paragraph until given the context-producing title. On the other hand, the Baseball/Factory paragraph of the present study seems to easily access a pre-existing cognitive structure, whether it be about baseball or about a factory, making it at once comprehensible and memorable. Thus, any possible effect of providing titles upon free recall are perhaps erased by the high comprehensibility of the paragraphs themselves. While context can be a powerful determiner of comprehension, and therefore, of memorability (Bransford & Johnson, 1972; Craik & Lockhart, 1972), when paragraphs are already highly comprehensible, they are less likely to show increased retention of information simply because of the presence of six-word titles.

Context cues were effective in increasing the amount of information recognized on the total information recognition measure which was defined as any correct response, whether it indicated one or the other possible interpretation of the paragraphs. The actual size of the effect was small considering the ω^2 value of .01 and results of post hoc comparisons. Means of the levels of context were ordered in decreasing size from strong, to weak, to no title, but the only significant difference appeared between the strong-meaning title and the no-title conditions, $p < .05$. Nevertheless, context-producing titles did increase significantly the number of "correct" multiple-choice responses selected. Perhaps, this measure of amount of information remembered was the only one to reflect differences due to context because it represented a more sensitive measure of available information (Tulving & Pearlstone, 1966). The title may have provided a small but significant advantage in the acquisition of information

by automatically supplying a cognitive structure for the new information (Haviland & Clark, 1974).

All three measures of amount of information remembered, number of idea units recalled, number of correct control recognition responses, and number of recognition responses consonant with either interpretation of the ambiguous passages, showed a consistent pattern of results. All three measures reflected similar and significant effects for task instructions, the variable designed to induce different levels of information processing. Consistent with a depth of processing model of memory, instructions to deal with passage content on a semantic level resulted in significantly higher memory scores than non-semantic instructions. Students asked to read and learn paragraphs or to rate them for ambiguity must attend to the meaning of the verbal symbols to fulfill task demands. On subsequent memory tests, these subjects remember much more of the information content of the paragraphs than subjects given non-semantic instructions. Interestingly, no significant difference was found between the two semantic tasks. This finding is consonant with previous indications that incidental tasks which require meaningful processing of stimuli often result in performance as good as, or nearly as good as, intentional instructions to learn (e.g., Bobrow & Bower, 1969; Frase & Kammann, 1974). Also, although mean performance was higher for students asked to count pronouns than for those asked to count number of four-letter words, it was not significantly higher. Thus, one could not reliably predict from these results that processing words at a syntactic level represents a deeper level of processing than processing words at a purely physical level.

The value of semantic instructions in influencing how much is remembered from prose is reflected in the relatively large omega squared values calculated for task effects in all three measures of memory capacity. Free recall particularly was strongly influenced by task instructions ($\omega^2 = .44$).

Again as predicted by a depth of processing model, subjects allowed to interact with the presented material for longer periods of time remembered more information. Only the control recognition responses did not show a significant increase in correct memory with longer exposure duration. It should be noted that while the difference between 20-second and 45-second exposure times was significant for recall and total information recognition measures, the duration variable controlled much less of the variance ($\omega^2 = .02$) than did task instructions. As Craik and Lockhart (1972) proposed, if stimuli are analyzed repeatedly at a "shallow" level of processing, an increase in time will not ensure better memory performance. Of greater importance is the degree to which task instructions and learners' intentions permit processing of the stimuli at a semantic level.

In summary, depth of comprehension, as manipulated by task instructions and by different presentation durations, effectively controlled the amount of information remembered from ambiguous prose passages. Furthermore, task instructions interacted with title conditions. Deep levels of processing improved memory for new information in two ways: more information, and more "accurate" or context-appropriate information, was remembered under the more semantic instructions than under the less semantic instructions.

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Footnote

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Table 1

Mean Proportions of Strong-Meaning Recognition Responses

Tasks	Context								
	Strong			Weak			None		
	20-sec.	45-sec.	Mean	20-sec.	45-sec.	Mean	20-sec.	45-sec.	Mean
Counting 4-letter words	.32	.53	.42	.30	.45	.37	.30	.33	.32
Counting pronouns	.43	.48	.45	.20	.30	.25	.27	.28	.27
Rating for ambiguity	.55	.60	.57	.32	.27	.29	.42	.37	.40
Normal learning	.55	.60	.57	.35	.20	.28	.47	.42	.44

Table 2

Mean Proportions of Weak-Meaning Recognition Responses

Tasks	Context								
	Strong			Weak			None		
	20-sec.	45-sec.	Mean	20-sec.	45-sec.	Mean	20-sec.	45-sec.	Mean
Counting 4-letter words	.23	.20	.22	.32	.17	.25	.27	.18	.22
Counting pronouns	.18	.25	.22	.30	.37	.34	.22	.33	.28
Rating for ambiguity	.27	.22	.24	.42	.55	.48	.30	.43	.36
Normal learning	.23	.22	.23	.48	.60	.53	.27	.42	.34